BNL-94999-2011-AB

THE INFLUENCE OF MIXED-PHASE CLOUDS ON SURFACE SHORTWAVE IRRADIANCE DURING THE ARCTIC SPRING

Dan Lubin, *Scripps Institution of Oceanography*
Andrew Vogelmann, *Brookhaven National Laboratory*

For presentation at
The Second Science Team Meeting of the
Atmospheric System Research (ASR) Program,
San Antonio, TX
March 28-April 1, 2011

Environmental Sciences Department/Atmospheric Sciences Division
Brookhaven National Laboratory

U.S. Department of Energy

Office of Science

ABSTRACT

The influence of mixed-phase stratiform clouds on the surface shortwave irradiance is examined using spectral irradiance measurements from the Indirect and Semi-Direct Aerosol Campaign (ISDAC). An Analytical Spectral Devices (ASD, Inc.) spectroradiometer measured downwelling spectral irradiance in the interval 350–2200 nm, in one-minute averages, throughout April–May 2008, from the ARM North Slope of Alaska (NSA) site at Barrow. The contrasting influences of mixed-phase clouds and liquid water clouds are discerned using irradiances in the 1.6 μm and 2.2 μm windows. Compared with liquid water clouds, mixed-phase clouds during the Arctic spring cause stronger attenuation of shortwave irradiance at the surface. At fixed conservative-scattering optical depth, the presence of ice water in cloud reduces the near-IR surface irradiance by an additional several watts per square meter. Typically, this additional forcing is ~3 watts per square meter near solar noon over Barrow, decreasing with increasing solar zenith angle. However, for some cloud decks this additional forcing can be as large as 5–6 watts per square meter. Mixed-phase clouds generally show larger conservative scattering optical depth than liquid-water clouds, implying that less shortwave irradiance tends to reach the surface at all wavelengths under mixed-phase clouds as compared with liquid-water clouds. Approximately 26% of the measurements were consistent with clouds having their optical properties dominated by liquid water; most of the rest were more consistent with a noticeable influence of ice particles.